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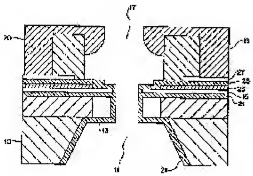
(54) MANUFACTURE OF THERMAL INK JET TYPE PRINT HEAD



(57)Abstract:
PROBLEM TO BE SOLVED: To realize the exact and easy alignment between a heat generating resistor for evaporating ink and a nozzle and, in addition, reduce cavitation damage and heighten ink feeding speed.
SOLUTION: By providing an annular frame so as to position in the fashion for surrounding a heat generating resistor 15 and forming a nozzle part 17 inside the annular frame by growing metal layer by plating, the automatical alignment between the heat generating resistor and the nozzle is realized. Thus, the manufacturing of a large-scaled print head becomes also possible. in order to make plating possible, an ink holding part 11 and the nozzle part 17 are directly connected with each other. On a beam locating between the ink holding part 11 and the nozzle part 17, the heat generating resistor 15 is provided. Thus, the effect such that the cavitating force due to the collapse of bubble is absorbed by the ink to be supplied and feeding of ink is also quick is realized.

CLAIMS

[Claim(s)]

[Claim 1]Provide a resistance heating element in a substrate that it should connect with an ink attaching part, and an annular frame located so that said resistance heating element may be surrounded on this board is provided, A manufacturing method of a heat ink jet type printing head having the process of forming a nozzle part by leaving an orifice opening inside and making it carrying out plating growth of the metal layer from said annular frame.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to an ink jet type printing head and its manufacturing method, and relates to the possible print head and manufacturing method of self alignment of a nozzle especially.
[0002]
[Description of the Prior Art]The conventional heat ink jet type printing head 2 is shown in Drawing 2. As the issue which should be technically solved in a heat ink jet, there is a problem of desorption of the problem 1 of an assembly, i.e., a nozzle plate. the former -- each nozzle plate 1 -- the -- as shown inA [3] figure, the resistant structure 3 is individually equipped with epoxy. This is a process where cost starts dramatically, and has a possibility of causing various problems. For example, in this work, alignment of the nozzle plate 1 does not sometimes often work. the [which shows conventional technology briefly] -- the fine portion is omitted inA [3] figure. Since various components of the heat ink jet print head 2 differ in a coefficient of thermal expansion, respectively, when adhesives harden, they have a tendency from which a nozzle plate tends to be desorbed. Since there was a problem of such adhesion, there was a fault that the number of nozzles will be restricted, in the conventional heat ink jet print head.
[0003]In the conventional heat ink jet print head 2, the replenishment speed of ink also becomes a problem. Printing speed is restricted by the replenishment speed. the -- in the conventional heat ink jet print head 2 shown inB [3] figure, ink reaches the nozzle 6 through the big slot 7 of friction which restricts the flow of ink.
[0004]U.S. Pat. No. 4,438,191 (an applicant's for this patent application is started.) called the "monolithic ink jet print head" quoted as a conventional example here In the invention indicated to JP,59-95156,A, the "monolithic ink jet print head" which can solve a part of above-mentioned problem is proposed. However, in manufacture of this print head, the following problems newly arise. That is, they are formation of an ink hole, removal of dry film ****** from a heat chamber (firing chamber) and other places, exact alignment of a nozzle, and other various manufacturing problems. The nozzle of the conventional monolithic print head was not able to be made to deploy (diverge).
[0005]When a bubble is crushed in the conventional ink jet print head, a shock is given to resistance again for supplement ink. When the power of this cavitation (pitting) was added repeatedly, there was a fault that resistance will break.
[0006]
[Problem(s) to be Solved by the Invention]A monolithic heat ink jet type printing head concerning this invention which formed the nozzle and the ink attaching part (ink well) in one, and a manufacturing method for the same solve the attachment of a nozzle and the problem of ink flow in the above-mentioned conventional print head.
[0007]This invention tends to reduce manufacturing costs and tends to attain the purpose of improving reliability. A part of cut in a manufacturing cost is attained by automation of the manufacturing process of removing all the difficulties of the alignment of an exothermic means and a nozzle. A part of reliability improvement is attained when the flow of the ink of a print head became smooth, that the life of resistance was prolonged,

and. In a heat ink jet type printing head, it will not become possible without this invention to constitute the print head array of page width.
[0008]
[Means for Solving the Problem]As a feature of this invention, as shown in Drawing 1, the nozzle 19 for which alignment is performed automatically is formed. In a conventional method, there was what (mistake aryne) the nozzle plate 1 illustrated to Drawing 2 shifts from the center. For a mistake aryne, a dot spreads and a print becomes slanting. Such a fault is removed by this invention.
[0009]The mono- RISHIRIKKU print head 20 of this invention lessens failure of resistance. In the conventional heat ink jet print head shown in Drawing 2, a shock is given to resistance for crushing of a bubble and a supplement of ink. A bubble crushed by the monolithic heat ink jet print head 20 shown in Drawing 1 collides with ink filled up. For this reason, ink absorbs most cavitation power. A cantilever beam to which the remaining cavitation power laid exothermic means, such as resistance, upwards (cantilever beam.) the following and an overhang section -- saying -- it is absorbed. A cantilever beam constituted with ductility nickel is formed in a form which is appearing into an ink attaching part. Mechanical force added to resistance is buffered by flexibility of a cantilever beam like ink itself.
[0010]According to this invention, printing speed is not restricted by replenishment speed of ink. As shown in Drawing 1, the ink attaching part 11 is directly connected to the heater element 15. Resistance to ink flow is reduced by this direct connection. For this reason, it is lost that printing speed is restricted with a replenishment speed of ink.
[0011]
[Example]Hereafter, this invention is explained based on the example shown in a drawing. Drawing 1 shows the sectional view of the monolithic heat ink jet type printing head which has the nozzle (integrated) and ink jar (it is called ink well, the following ink supply, or the ink attaching part) concerning the example manufactured by this invention method which were formed in one. Drawing 4 shows the top view of the monolithic print head 20. An ink attaching part is in the substrate 10, and holds and supplies ink. The resistive layer 15 which is an exothermic means (heater element) evaporates ink. Gaseous ink (a steam, glycol, and ink pigment particles) moves to the nozzle part 17. The compound boa (hole which has compound bore:, for example, continuous curved surface of inside diameter which carries out center in common and is different) nozzle 19 leads this Gaseous, Inc. so that it may make ink emit from a nozzle with the accumulated pressure of Gaseous, Inc.
[0012]The thermal barrier 21, i.e., a thermal break, prevents heat from flowing into the cantilever beam (overhang section) 12 of nickel, and the nickel substrate 40. With such a combination, the heat from the resistive layer 15 heats ink, and does not become useless within the print head 20. (Predetermined) The conductor layer 23 formed in the pattern short-circuits the resistive layer 15 except for the cantilever beam 12 top. The protective layer 25 serves to prevent the short circuit by the nickel-plating in process for forming the nozzle 19, and the conductor 23. The protective layer 25 also protects the chemical mechanical damage of each class again. The conductor layer 27 is laminated into a manufacturing process that the field for making the nozzle 19 constitute should be formed. That is, the nozzle 19 is constituted on the field.
[0013]The process of manufacturing the monolithic heat ink jet type printing head 20

consists of some stages. the -- sputtering art is used and about 1000 A (about 0.1 micrometer) conductor layer 30 is made to laminate on the glass shown inA [5] figure, or the substrate 10 of silicon By energizing to the conductor layer 30, processing which makes the surface the field which can perform nickel plating is performed. the [next,] -- as shown inB [5] figure, the dry film mask 32 is put on the conductor layer 30. This mask 32 is 3 mils (from about 50 micrometers to 75 micrometers) from the diameter 2, and positions the cantilever beam 12 of Drawing 1, and 13 of Drawing 9. the --C [5] figure shows various another examples which the mask 32 can take. The mask 38 corresponds to the print head 20 shown in Drawing 4. The mask 34 corresponds to the print head 60 shown in Drawing 10.

[0014]Next, the 1 to 1.5 mils (from about 25 micrometers to 38 micrometers) nickel layer 40 is formed in the exposed substrate 10 by electroplating. The cantilever beam 12 is carried out in this way, and is formed. removing the dry film mask 38 after the end of plating -- the -- the cantilever beam 12 shown inB [6] figure is exposed. The attaching part 11 is also formed of the process of a multi stage story. First, the protective metal layer 42 is made to laminate by sputtering. This layer consists of gold and thickness is 1000 A (0.1 micrometer). Next, the position of an attaching part is decided with the mask 44. And the attaching part 11 is formed according to the chemical wet etching processes which were said to silicon as KOH and said to glass as HF. if the attaching part 42 and the mask layer 44 are removed -- the -- it becomes structure as shown inC [6] figure.

[0015]Next, the thermal break 21 which consists of a dielectric material of SiO2 by LPCVD (vacuum CVD method: low pressure chemical vapor deposition) and others is made to laminate. This is laminated on the surroundings of the cantilever beam 12 by a thickness of 1.5 micrometers the inside of the attaching part 11, and on the nickel plating layer 40, as shown in Drawing 1 and Drawing 7. The thermal break 21 helps for the resistive layer 21 to work efficiently. the thermal break 21 top -- the [of Drawing 1] -- the resistive layer 15 which comprises materials, such as tantalum aluminum, as shown inA [7] figure is laminated on a thickness of 1000 (0.1 micrometer) to 3000 A (0.3 micrometer). Next, pattern attachment of the conductor layer 23 which consists of 5000 A (0.5 micrometer)-thick gold or aluminum is carried out selectively, and it short-circuits a part of resistive layer 15 with the resistive layer 15. There is no conductor layer 23 in a cantilever beam, therefore the resistive layer 15 can commit it with a cantilever beam. On the conductor layer 23, the protective layer which comprises silicon carbide (SiC), and Si3 N4 and other dielectric materials is laminated using an LPCVD method. This layer protects a print head from a chemical mechanical damage.

[0016]The conductor layer 27 is laminated on the protective layer 25 by a thickness of 1000 to 5000 A (0.1 to 0.5 micrometer). This is formed of sputtering. The conductor layer 27 makes the field which forms the nozzle 19 by electroplating. the [next,] -- the predetermined part of the conductor layer 27 is etched and it is made only for the remaining conductor layers 27 to be located in the fundus of the nozzle formed by wet etching processes, as shown inB [7] figure

[0017]Next, the dry film block 52 of doughnut shape is laminated in the conductor layer 27. These blocks 52 make the frame for forming the nozzle 19. In this example, the nozzle 19 is constituted like two steps of platers. the time of the first process being completed -- the -- it is shown inA [8] figure. the base of the nozzle 19 is formed in the conductor layer 27 of electroplating by a thickness of 1.5 to 2.0 mils (about 38 to 51

micrometers) -- this -- thickness (final) -- it is equal to the height of the nozzle 19. next, a glass plate or the other plate-like dielectric materials 56 -- the -- as shown inB [8] figure, it pushes against the nozzle 19. This board 56 acts as a mold of the nozzle 19 in the 2nd step of a nickel-plating process. furthermore -- continuing an electroplating process -- the -- the nozzle 19 is formed as shown inC [8] figure. The board 56 is removed after the nozzle 19 is completed. As a result, the print head 20 as shown in Drawing 1 is constituted.

[0018]The nozzle 19 may be formed using other methods. For example, the board 56 cannot be used but the nozzle 19 can also be constituted like the plater of a single step.

[0019]Drawing 9 shows other examples of the print head 20. The nozzle 19 of this form should also be called a compound boa. This adjusts the ink flow emitted from the nozzle 19. The ink flow emitted from a compound boa nozzle has a small diameter, and its breadth is very slight. The cantilever beam (overhang section) 13 is projected towards the center.

The heating element 15 is laid on this overhang section 13.

The example of this print head is formed by the same method as the print head 20 shown in Drawing 1. The main differences at a process are the molds of the mask used when plating the layer 40 to the substrate 10. Instead of the mask 38 for cantilever beam 12, the mask 34 or a mask like 36 is used.

[0020]In the example of above-mentioned this invention, although a print head ejects ink and this ink was explained as what is a thing containing water, glycol, and pigment particles, it cannot be overemphasized that it can use for ejecting other substances, either.

[0021]

[Effect of the Invention]The print head concerning this invention is formed in [a nozzle part and an ink attaching part] one as mentioned above.

Since the heating element is laid in the overhang section located between them, the cavitation power by crushing of a bubble etc. is buffered in supplement ink, the damage which a heating element receives becomes very small, and the effect that a life is prolonged by leaps and bounds is acquired.

The effect that a reliable print head can be provided by that cause is acquired. Since the nozzle part and the ink attaching part are connected directly, the replenishment speed of ink becomes quick and the effect referred to as being able to attain improvement in the speed of the printing speed itself is acquired. The manufacturing method of the print head concerning this invention, Since positioning of a heating element and a nozzle is not performed independently but both position is in agreement naturally in a manufacturing process, It is hard to produce a position gap theoretically, and the breadth and the inclination of a dot by a mistake aryne are prevented, and since careful alignment work like before is unnecessary, the effect that reduction of a manufacturing cost can be aimed at is acquired. The effect that a print head which has many nozzles over the wide range can be manufactured is acquired.